APPENDIX E

PHASE II FORWARD FLOW PARAMETERS

PHASE II FORWARD FLOW PARAMETERS
JET PROPULSION LABORATORY

			REACTOR 1						REACTOR 2						
DATE	TIME	SAMPLE PORT	Flow (gpm)	pH	Temp (°C)	Turbidity (NTU)	Cond (mS/cm)	DO (mg/L)	Flow (gpm)	pH	Temp (°C)	Turbidity (NTU)	Cond (mS/cm)	DO (mg/L)	Comments
8/26/2002	9:30am	N/A	3.3	-	-	-	-	-	2	-	-	-	-	-	Began forward flow testing; Substrate (Acetate) Feed Conc. About 300 mg/L (as Ac-)
	12:40pm	N/A	2.5	-	-	-	-	-	2.5	-	-	-	-	-	Balanced flows between reactors
	5:00pm														Put R1 in recirculation mode (needed to repair leak); added NaAc (hyd) to recirculating water
8/27/2002	8:00am														R2 down upon arrival to site (shut down 4-4.5 hours due to high water level)
	9:45am	N/A	2.5	-	-	-	-	-	2.5	-	-	-	-	-	Resume forward flow through R1
	10:45am	INFLUENT	-	7.34	-	-10	1.34	7	-	7.39	20.8	-10	1.24	5.25	Begin using Horibu U10 water quality checker
		INTERMED	N/A	7.45	-	-10	1.33	3	N/A	7.82	21.2	-10	1.25	1.67	
		EFFLUENT	N/A	7.55	-	-10	1.36	1.34	N/A	7.55	21.2	-10	1.36	1.34	
	4:00pm														Began diluting substrate feed to 150 mg/L for R2
	4:30pm														Qtot(R1) = 1918.1 gal; Qtot(R2) = 3519.2 gal
8/28/2002	7:30am														Qtot(R1) = 2913.1 gal; Qtot(R2) = 4444 gal
															R1/R2 influent pumps off upon arrival to site to to high water levels (est. 4-4.5 hours overnight, 2 hours today)
	11:00am	INFLUENT	-	7.66	20.7	1	1.42	5.25	-	7.48	20.6	0	0.909	5.56	
		INTERMED	N/A	8.0	21.2	2	1.41	1.36	N/A	8.04	21.0	3	0.949	2.32	
		EFFLUENT	N/A	8.24	21.7	3	1.4	1.04	N/A	8.27	21.5	5	0.968	0.94	
	11:45am														Collected samples for lab analysis; diluting substrate feed into R1 to 150 mg/L
	4:00pm														24-hour feed rate for nutrient solution = 8.3 gph
	5:45pm	INFLUENT	2.48	-	-	-	-	-	2.5	-	-	-	-	-	Qtot(R1) = 3958.3 gal; Qtot(R2) = 5491 gal
8/29/2002	7:20am														Qtot(R1) = 5761 gal; Qtot(R2) = 7527 gal (R1 flowmeter was not reading upon arrival to site)
	8:00am	INFLUENT	-	7.03	19.4	-8	0.933	5.61	-	7.13	19.3	-8	0.843	5.84	
		INTERMED	N/A	7.67	19.4	-4	0.923	1.43	N/A	7.53	19.4	-4	0.824	2.9	Noticed air in line in R2 outlet
		EFFLUENT	N/A	8.01	19.4	<0	0.916	0.60	N/A	7.84	19.3	Error	0.811	1.1	
	3:30pm	INFLUENT	-	7.31	21	-8	0.756	5.06	-	7.33	21.1	-8	0.725	5.02	
		INTERMED	N/A	7.78	21.9	-1	0.74	1.32	N/A	7.61	21.4	Error	0.718	3.27	
		EFFLUENT	N/A	8.01	22.2	Error	0.743	0.91	N/A	7.94	21.7	Error	0.699	1.33	
	4:10pm														Feed rate for nutrient sol'n about 3 gph during day (9a-4p)
8/30/2002	7:30am	INFLUENT	1.9	-	-	-	-	-	2.83	-	-	-	-	-	Qtot(R1) = 9054 gal; Qtot(R2) = 11348 gal; Q (nutrient feed) = 2.2 gph (16 hr avg.)
	8:15am	INFLUENT	-	7.16	19.2	Error	0.813	5.41	-	7.15	19.2	Error	0.704	5.49	
		INTERMED	N/A	7.74	19.3	Error	0.799	1.18	N/A	7.47	19.2	Error	0.701	3.25	
		EFFLUENT	N/A	8.05	19.3	Error	0.784	0.78	N/A	7.82	19.3	Error	0.696	1.43	
	8:50am														Collect forward flow samples
	3:30pm														Put system in recirculation mode; added nutrients, acetate as required
9/3/2002	11:45am														Resume forward flow operation; balance flows @ 2.5 gpm each
	1:30pm	INFLUENT	-	7.42	22.2	0	0.568	-	-	7.53	22.2	1 or 2	0.551	-0.8	
		INTERMED	N/A	7.53	22.7	3	0.55	-0.78	N/A	7.75	22.9	10 or 11	0.554	-0.72	
		EFFLUENT	N/A	7.51	23.4	Error	0.784	0.78	N/A	7.82	19.3	Error	0.696	1.43	
	4:30pm	INFLUENT	2.42	-	-	-	-	-	2.53	-	-	-	-	-	Qtot(R1) = 10,743.7 gal; Qtot(R2) = 13,360.4 gal
9/4/2002	7:35am	INFLUENT	1.94	-	-	-	-	-	2.78	-	-	-	-	-	Qtot(R1) = 12701.5 gal; Qtot(R2) = 15808.9 gal; Qavg.R1 = 2.2 gpm; QavgR2 = 2.7 gpm
	8:00am	INFLUENT	-	7.46	20.3	0	0.577	9.75	-	7.47	20.2	0	0.537	9.82	Nutrient Tank Feed Rate overnight = 4.2 gph
		INTERMED	N/A	8.16	20.4	5	0.564	9.75	N/A	7.78	20.3	7	0.519	9.78	Substrate #1 Feed overnight = 4.2 gph
		EFFLUENT	N/A	8.34	20.4	7	0.549	9.73	N/A	8.13	20.4	10	0.514	9.74	Substrate #2 Feed overnight = 3.5 gph
	8:25am														Collect forward flow samples (substrate feed C still 150 mg/L)
	2:30pm	INFLUENT	-	7.46	22.7	1	0.568	8.76	-	7.46	22.4	2	0.583	8.89	Begin feeding Substrate at 100 mg/L (still some 150 mg/L soln in 150 gal tanks)
		INTERMED	N/A	8.07	22.8	5	0.591	8.65	N/A	7.73	22.5	6	0.565	8.86	
		EFFLUENT	N/A	8.31	23.2	6	0.597	8.57	N/A	8.08	22.8	10	0.555	8.73	
	4:l0pm	INFLUENT	2.33-2.52	-	-	-	-	-	2.34-2.51	-	-	-	-	-	Qtot(R1) = 13934 gal; Qtot(R2) = 17052 gal; adjusted pump speeds to increase flow
	4:50pm	INFLUENT	2.3	-	-	-	-	-	3	-	-	-	-	-	Cannot balance flows by throttling flow into R2; need to let flow preferentially flow through both reactors
9/5/2002	8:30am	INFLUENT	1.52	-	-	-	-	-	3.19	-	-	-	-	-	Qtot(R1) = 15810.1 gal; Q avg. (16h) = 1.3 gpm; Qtot(R2) = 20020.3 gal; Q avg. (16 hr) = 3.1 gpm
															Nutrient Feed Avg. 2.6 gph (16h); SF#1 Avg. = 5.3 gph; SF#2 Avg. = 4.2 gph (16h)
															Rebalanced flows through R1, R2 to 2.5 gpm by throttling flow into R1
	9:10am	INFLUENT	-	7.2	21	1	0.576	5.7	-	7.28	20.8	0	0.593	5.6	D.O. Readings taken with new instrument (YSI Model 51B)
		INTERMED	N/A	7.78	21	2	0.607	1.6	N/A	7.54	21.1	5	0.575	3.7	
		EFFLUENT	N/A	8.03	21.3	3	0.609	0.8	N/A	7.83	21.2	8	0.561	1.85	
	2:30pm	INFLUENT	1.71	-	-	-	-	-	3.18	-	-	-	-	-	Qtot(R1) = 16577 gal; Qtot(R2) = 21009 gal
															Delta P for GAC vessel = 11 psi
9/6/2002	8:00am	INFLUENT	1.26	-	-	-	-	-	3.19	-	-	-	-	-	Qtot(R1) = 18054 gal; QR1 Avg. 1.37 gpm; Qtot(R2) = 24485 gal; QR2 Avg. 3.21 gpm
															Nutrient Feed Avg. 2.6 gph
															ST#1 Avg. = 6.02 gph; ST#2 Avg. = 5.96 gph
	8:25am	INFLUENT	-	7.27	20.9	0	0.686	5.9	-	7.48	20.6	0	0.538	5.2	D.O Readings taken with YSI Model 51B
		INTERMED	N/A	8.18	21	4	0.662	1.1	N/A	7.64	20.6	2	0.542	3.6	
		EFFLUENT	N/A	8.26	21.3	4	0.656	0.7	N/A	7.92	21	4	0.535	2.1	
	9:30am														Collect forward flow samples
	10:45am														Change metering pump settings based on QR1 = 1.25 gpm; QR2 = 3.25 gpm
	2:50pm	INFLUENT	-	7.45	22.1	2	0.561	6.5	-	7.5	21.9	1	0.671	6	

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			REACTOR 1						REACTOR 2						
DATE	TIME	SAMPLE PORT	Flow (gpm)	pH	Temp (°C)	Turbidity (NTU)	Cond (mS/cm)	DO (mg/L)	Flow (gpm)	pH	Temp (°C)	Turbidity (NTU)	Cond (mS/cm)	DO (mg/L)	Comments
		INTERMED	N/A	8.2	22.6	6	0.567	1.4	N/A	7.64	21.9	2	0.668	4.2	
		EFFLUENT	N/A	8.3	23.1	5	0.564	1.2	N/A	7.91	22.3	4	0.661	2.02	
	12:45pm														Made down substrate feed tanks (added excess acetate -- see field logbook)
	3:35pm	INFLUENT	1.36	-	-	-	-	-	3.47	-	-	-	-	-	Qtot(R1) = 18623.2 gal; Qtot(R2) = 25908.6 gal
															Pressure Drops: R1-1 = 6 psi; R1-2 = 6 psi; R2-1 = 13 psi; R2-2 = 7 psi; GAC = 13 psi
	8:00am	INFLUENT	0	-	-	-	-	-	0	-	-	-	-	-	Qtot(R1) = 21,896 gal; Qtot(R2) = 33,305 gal (avg. 0.9 gpm for R1, 1.9 gpm for R2 over 65 hours)
															Delta P for GAC vessel = 5 psi
															System down due to high WL in EQ Tank #1
	10:30am														Put system in recirculation mode; reduce pumpthrough flow, feed rate for substrate, nutrients proportionally
9/9/2002															
	4:00pm	INFLUENT	-	7	24	-10	0.795	3.9	-	8.67	23.9	-10	0.868	3.9	Measure parameters with Horiba U10 and YSI Model 51B (DO)
		INTERMED	N/A	8.41	25.1	-10	0.77	1.4	N/A	8.45	24.3	-10	0.878	1.9	
		EFFLUENT	N/A	8.48	25	-10	0.719	0.8	N/A	8.54	24.6	-10	0.871	1	
	4:30pm	INFLUENT	1.1	-	-	-	-	-	2.1	-	-	-	-	-	Qtot(R1) = 22,349 gal; Qtot(R2) = 34,298 gal
	7:30am	INFLUENT	1.02	-	-	-	-	-	2.38	-	-	-	-	-	Qtot(R1) = 23,308 gal; Qtot(R2) = 36,370 gal (avg. 1.07 gpm for R1, 2.3 gpm for R2 overnight)
															Delta P for GAC vessel = 5 psi
															System down due to high WL in EQ Tank #1
9/10/2002	8:30am	INFLUENT	-	7.65	23.6	-	-	0.8	-	7.68	23.5	-	-	1.2	Measure parameters with YSI Model 3500 (pH, T) and YSI Model 51B (DO)
		INTERMED	N/A	7.58	23.3	-	-	2.2	N/A	7.67	23.9	-	-	0.9	
		EFFLUENT	N/A	7.59	23.1	-	-	1	N/A	7.74	23.4	-	-	0.7	
	12:50pm	INFLUENT	1.1	-	-	-	-	-	2.5	-	-	-	-	-	Collect samples for laboratory analysis
															Qtot(R1) = 23,621 gal; Qtot(R2) = 37,148 gal; turned on aerator in 1,100 gallon tank
	10:30am	INFLUENT	1.5	-	-	-	-	-	3.5	-	-	-	-	-	Set groundwater and following flows: Q(SF#1) = 3.4 gph; Q(SF#2) = 8 gph; Q(NF) = 3 gph
	3:25pm	INFLUENT	-	7.44	23	-	-	4	-	7.59	22.5	-	-	4	
9/11/2002		INTERMED	N/A	8.01	23.9	-	-	1.45	N/A	7.8	22.8	-	-	2.1	
		EFFLUENT	N/A	7.9	24.3	-	-	1.4	N/A	8.12	23.1	-	-	1.4	
	4:15pm	INFLUENT	1.25	-	-	-	-	3.5	-	-	-	-	-	-	Set Q pumpout from 1,100 gal tank
	8:20am	INFLUENT	0.6	-	-	-	-	-	3.7	-	-	-	-	-	Qtot(R1) = 26638 gal; Qtot(R2) = 44626 gal; Q(R2) v. low since head in 1,100 gal tank low (Q out >> Q in)
															Pressure Readings: R1-INF = 34 psi; R1-INT = 4 psi; R1-EFF = 0 psi; R2-INF = 16 psi; R2-INT = 6 psi; R2-EFF = 0 psi
	9:30am	INFLUENT	2	-	-	-	-	-	3	-	-	-	-	-	P1INF pressure decr. From 34 psi to 25 psi; P2INF incr. From 16 to 18 psi
9/12/2002	1:00pm	INFLUENT	-	7.85	25	-	-	2	-	7.83	24.7	-	-	1.8	
		INTERMED	N/A	7.74	24.7	-	-	1.5	N/A	7.81	24.7	-	-	0.8	
		EFFLUENT	N/A	7.77	24.7	-	-	1.1	N/A	7.76	24.9	-	-	0.9	
	4:00pm	INFLUENT	1.83	-	-	-	-	-	3.06	-	-	-	-	-	Qtot(R1) = 27,424 gal; Qtot(R2) = 46,074 gal
	11:00am	INFLUENT	-	7.92	24.9	-	-	2.8	-	7.97	24.9	-	-	2.7	
9/13/2002		INTERMED	N/A	7.83	25.8	-	-	1	N/A	7.92	25.5	-	-	1.3	
		EFFLUENT	N/A	7.8	26	-	-	1	N/A	7.85	25.7	-	-	1	
	8:00am	INFLUENT	1.6	-	-	-	-	-	2.2	-	-	-	-	-	Qtot(R1) = 36,938 gal; Qtot(R2) = 58,825 gal
9/16/2002	11:30am	INFLUENT	-	7.95	23	-	-	0.6	-	Same for both					
		INTERMED	N/A	7.82	23.9	-	-	0.2	-	7.96	23.7	-	-	0.2	
		EFFLUENT	N/A	7.81	24.5	-	-	0.2	-	7.89	24.2	-	-	0.2	
	8:00am	INFLUENT	NR	-	-	-	-	-	NR	-	-	-	-	-	Pressure Drops: R1-1 = 24.5 psi; R1-2 = 3.5 psi; R2-1 = 19 psi; R2-2 = 5 psi
	8:45am	INFLUENT	-	7.89	20.2	-	-	0.2							
9/17/2002		INTERMED	N/A	7.89	20.3	-	-	0.2							
		EFFLUENT	N/A	7.86	20	-	-	0.1	System Shut Down @ 0820						
	1:30pm														Collect samples for laboratory analysis (reactor 1 only -- still in recirculation mode)
	9:30am	INFLUENT	-	7.9	22.7	-	-	0.6							
9/18/2002		INTERMED	N/A	7.88	23.2	-	-	0.3							
		EFFLUENT	N/A	7.83	22.7	-	-	0.5	System Shut Down						
9/19/2002															R1 in recirculation mode; R2 shut down; QR1 = 1 gpm
9/20/2002															R1 in recirculation mode; R2 shut down; flow recirculated through sm. Start-up tanks; aerating R1 w/ submersbile aerator/compressor
9/23/2002	9:15am	INFLUENT (TANK)	-	8.23	26.9	-	-	0.2							(After readings): Introduce fresh GW into start-up tank; Added acetate into start-up tank
		INTERMED	N/A	8.2	27.2	-	-	0.1							
		EFFLUENT	N/A	8.17	27	-	-	0.1	System Shut Down						
9/24/2002		No Data							System Inoculated with perc1ase						
9/25/2002	10:00am	INFLUENT (TANK)	-	8.23	26.9	-	-	0.2	-	6.67	27.6	-	-	0.55	
		INTERMED	N/A	8.2	27.2	-	-	0.1	N/A	6.7	27.7	-	-	1.3	
		EFFLUENT	N/A	8.17	27	-	-	0.1	N/A	6.69	28	-	-	0.95	

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			REACTOR 1						REACTOR 2						
DATE	TIME	SAMPLE PORT	Flow (gpm)	pH	Temp (°C)	Turbidity (NTU)	Cond (mS/cm)	DO (mg/L)	Flow (gpm)	pH	Temp (°C)	Turbidity (NTU)	Cond (mS/cm)	DO (mg/L)	Comments
9/26/2002	9:30am	INFLUENT (TANK)	-	7.79	24	-	-	1.6	-	6.87	25.3	-	-	0.3	Measured [ClO_4^-] in sample from R2 effluent using perchlorate probe; [ClO_4^-] was < 1 mg/L
		INTERMED	N/A	7.95	24.5	-	-	1	N/A	6.89	25.5	-	-	1.7	
		EFFLUENT	N/A	7.99	24.2	-	-	0.9	N/A	6.88	25.9	-	-	0.7	
	11:00am														Begin aerating R2
9/27/2002	10:00am	INFLUENT (TANK)	-	8.17	22	-	-	5.6	-	8.2	22.8	-	-	0.3	
		INTERMED	N/A	8.06	21.5	-	-	4.7	N/A	8.22	22.8	-	-	0.3	
		EFFLUENT	N/A	8.12	21.8	-	-	4.8	N/A	8.22	22.9	-	-	0.1	
	10:10am														Add e- donor (acetate) to R1
	2:30pm	INFLUENT (TANK)	-	-	-	-	-	1.8	-	-	-	-	-	-	
		INTERMED	N/A	-	-	-	-	1.5	-	-	-	-	-	-	
		EFFLUENT	N/A	-	-	-	-	0.95	-	-	-	-	-	-	
9/30/2002	10:15am	INFLUENT (TANK)	-	8.81	18.9	-	-	1.5	-	8.49	19.8	-	-	4.8	Both R1 and R2 in recirculation mode w/ start-up tanks; water is being aerated
		INTERMED	N/A	8.16	19.2	-	-	1	N/A	8.49	20	-	-	4.6	
		EFFLUENT	N/A	8.13	19.3	-	-	0.9	N/A	8.49	20	-	-	4.5	
	2:15pm														Add e- donor (acetate) to R2
10/1/2002	8:45am	INFLUENT (TANK)	-	8.29	20.2	-	-	0.8	-	8.57	20.8	-	-	0.2	R1/R2 in recirculation mode w/ aeration (final check)
		INTERMED	N/A	8.34	20.4	-	-	0.6	N/A	8.57	20.6	-	-	0.1	
		EFFLUENT	N/A	8.35	20.2	-	-	0.6	N/A	8.56	20	-	-	4.5	
	11:15am														Resume forward flow testing for R1 and R2 at approx. 1 gpm/each; Q(SF#1) = 2 gph; Q(SF#2) = 1.25 gph; Qtot(R1),(R2) = 0
	1:00pm														Pressure Drop through R1 = 15 psi, R2 = 5 psi, GAC = 3 psi
	4:00pm	INFLUENT	-	7.2	19.9	-	-	8	-	Same for both					
		INTERMED	N/A	8.19	19.8	-	-	2.4	N/A	7.84	19.7	-	-	2	
		EFFLUENT	N/A	8.53	19.6	-	-	2.2	N/A	7.69	19.4	-	-	2.5	Final Effluent (new sample port): pH = 7.69, T = 19.4, DO = 2.5
	4:45pm	INFLUENT	1.1	-	-	-	-	-	1.14	-	-	-	-	-	Qtot(R1) = 301 gal; Qtot(R2) = 299 gal; PR2, inlet = 8 psi; PR1, inlet = 18 psi
10/2/2002	9:00am	INFLUENT	0.9	-	-	-	-	-	1	-	-	-	-	-	Qtot(R1) = 1174 gal; (avg. for 16 hr = 0.9 gpm); Qtot(R2) = 1261 gal (avg. for 16 hr = 1.0 gpm)
	9:15am	INFLUENT	-	7.3	18.8	-	-	7.4	-	Same for both					
		INTERMED	N/A	8.46	18.1	-	-	2.2	N/A	8.28	18	-	-	2.3	
		EFFLUENT	N/A	8.61	17.3	-	-	2	N/A	8.48	17.5	-	-	2.2	Final Effluent (new sample port): pH = 8.63, T = 17.2, DO = 2.25
	10:20am														Collected samples for lab analysis
	3:00pm	INFLUENT	-	7.01	20	-	-	7.3	-	Same for both					
		INTERMED	N/A	8.37	19.9	-	-	1.5	N/A	8.39	19.9	-	-	1.5	
		EFFLUENT	N/A	8.61	20	-	-	1.5	N/A	8.5	20.1	-	-	1.2	Final Effluent (new sample port): pH = 8.28, T = 21.8; DO = 1.8
10/3/2002	9:30am	INFLUENT	1.04	-	-	-	-	-	0.73	-	-	-	-	-	Qtot(R1) = 2786 gal; (avg. for 24 hr = 1.1 gpm); Qtot(R2) = 2469 gal (avg. for 24 hr = 0.85 gpm)
															Q nut = 1.1 gph; Q(ST#1) = 2.2 gph; Q(ST#2) = 3 gph
	11:00am	INFLUENT	-	7.52	20.2	-	-	8.2	-	Same for both					
		INTERMED	N/A	8.41	20.9	-	-	1.3	N/A	8.41	21.3	-	-	1.6	
		EFFLUENT	N/A	8.59	20.9	-	-	1.35	N/A	8.5	21.5	-	-	1.2	Final Effluent (new sample port): pH = 8.54, T = 22.7, DO = 0.7
	3:30pm	INFLUENT	1.03	-	-	-	-	-	0.94	-	-	-	-	-	Qtot(R1) = 3153 gal; Qtot(R2) = 2822 gal; R1 Inlet P = 18 psi; R2 inlet P = 12 psi
10/4/2002	9:30am	INFLUENT	0.7	-	-	-	-	-	0.68	-	-	-	-	-	Qtot(R1) = 3982 gal, Qavg. =0.77 gpm; Qtot(R2) = 3767 gal, Qavg. = .875 gpm; R1 inlet P = 18 psi; R2 inlet P = 16 psi
															Q nut = 0.8 gph; Q(ST#1) = 2 gph; Q(ST#2) = 1.7 gph
	10:00am	INFLUENT	-	7.27	20	-	-	7.9	-	Same for both					
		INTERMED	N/A	8.37	19.8	-	-	1.8	N/A	8.41	19.9	-	-	1.5	
		EFFLUENT	N/A	8.51	19	-	-	1.4	N/A	8.43	19.1	-	-	1.1	Final Effluent: pH = 8.45, T = 19.0, DO = 0.8
	10:15am														Collect samples for analysis
	11:10am	INFLUENT	0.8	-	-	-	-	-	0.93	-	-	-	-	-	Increase Q to approx. 1 gpm for both R1, R2
10/7/2002	9:15am	INFLUENT	1.03	-	-	-	-	-	0.63	-	-	-	-	-	Qtot(R1) = 8118 gal, Qavg. =0.96 gpm (72 hr); Qtot(R2) = 7216 gal, Qavg. = .8 gpm
															Pressures: R1 - Inlet (21 psi), Int - (2 psi), Outlet - (0 psi); R2 - Inlet - (13 psi), Int - (5 psi), Oulet - (0 psi)
															Q nut = 0.8 gph
	10:00am	INFLUENT	-	7.06	21.5	-	-	6.7	-	Same for both					
		INTERMED	N/A	7.97	21.8	-	-	0.6	N/A	8.17	22.5	-	-	0.8	
		EFFLUENT	N/A	8.24	21.6	-	-	0.8	N/A	8.21	23.4	-	-	0.8	Final Effluent: pH = 8.21, T = 23.4, DO = 0.8; Increased Q(R2) to about 1 gpm
	10:15am														Collect samples for analysis
	3:20pm	INFLUENT	-	7.12	22.4	-	-	7.2	-	Same for both					
		INTERMED	N/A	8.1	23.2	-	-	1.1	N/A	8.18	23.5	-	-	0.8	
		EFFLUENT	N/A	8.33	23.8	-	-	0.8	N/A	8.2	24.3	-	-	0.65	Final Effluent: pH = 8.23, T = 26.8, DO = 0.6
	4:10pm														Increased Q(R2) to about 1 gpm; Qtot(R1) = 8519 gal; Qtot(R2) = 7646 gal
10/8/2002	11:30am	INFLUENT	1.14	-	-	-	-	-	1.04	-	-	-	-	-	Qtot(R1) = 9605 gal, Qavg. = 1.06 gpm; Qtot(R2) = 8,602 gal, Qavg. = 0.94 gpm
	1:20pm	INFLUENT	1.17	7.24	21.7	-	-	6.2	1.2	Same for both					
		INTERMED	N/A	7.91	22.3	-	-	1.3	N/A	7.99	22.5	-	-	1	
		EFFLUENT	N/A	8.1	23	-	-	0.8	N/A	8.06	23.7	-	-	0.6	Final Effluent: pH = 8.07, T = 23.7, DO = 0.6
	2:45pm														Collect samples for analysis
	4:00pm	INFLUENT	1	-	-	-	-	-	1	-	-	-	-	-	Readjusted R1/R2 Q's; Qtot(R1) = 9908 gal; Qtot(R2) = 8934 gal

PHASE II FORWARD FLOW PARAMETERS
JET PROPULSION LABORATORY

			REACTOR 1						REACTOR 2						
DATE	TIME	SAMPLE PORT	Flow (gpm)	pH	Temp (°C)	Turbidity (NTU)	Cond (mS/cm)	DO (mg/L)	Flow (gpm)	pH	Temp (°C)	Turbidity (NTU)	Cond (mS/cm)	DO (mg/L)	Comments
10/9/2002	9:30am	INFLUENT	0.96	-	-	-	-	-	0.5	-	-	-	-	-	Qtot(R1) = 10,938 gal, Qav = 1 gpm (17 hr), Qtot(R2) = 9730 gal, Q av = 0.78 gpm (17 hr)
	10:00am	INFLUENT	-	7.09	20.2	-	-	6.8	-	Same for both					Pressures: R1 - Inlet (18 psi), Int (4.5 psi), Outlet (0 psi); R2 - Inlet - (11 psi), Int - (2.5 psi), Outlet - (0 psi)
		INTERMED	N/A	7.98	20.4	-	-	1	N/A	7.98	20.4	-	-	1.2	Nut Q = 0.94 gph; SF#1/#2 = 1.6 gph; Increase QR2 to 1 gpm
		EFFLUENT	N/A	7.98	20.4	-	-	1.2	N/A	7.95	19.7	-	-	1.2	Final Effluent: pH = 8.16, T = 19.8, DO = 0.9
	5:00pm	INFLUENT	1.02	-	-	-	-	-	1.01	-	-	-	-	-	Qtot(R1) = 11,021 gal; Qtot(R2) = 10,423 gal
10/10/2002	7:00am	INFLUENT	1.03	-	-	-	-	-	0.66	-	-	-	-	-	Qtot(R1) = 11,896 gal, Qav = 1 gpm (14 hr), Qtot(R2) = 11,090 gal, Q av = 0.79 gpm (14 hr)
	8:50am	INFLUENT	-	7.16	19.7	-	-	6.7	-	Same for both					
		INTERMED	N/A	8.11	19.4	-	-	1.5	N/A	8.37	19.3	-	-	1.3	
		EFFLUENT	N/A	8.27	19.1	-	-	1.2	N/A	8.38	19.1	-	-	1.2	Final Effluent: pH = 8.32, T = 18.9, DO = 0.9
	4:15pm	INFLUENT	0.97	-	-	-	-	-	1	-	-	-	-	-	Qtot(R1) = 12,345 gal; Qtot(R2) = 11683 gal
10/11/2002	9:30am	INFLUENT	-	6.75	20.1	-	-	7.2	-	Same for both					Pressures: R1 - Inlet (18 psi), Int (4.5 psi), Outlet (0 psi); R2 - Inlet - (11 psi), Int - (2.5 psi), Outlet - (0 psi)
		INTERMED	N/A	7.78	20	-	-	1.1	N/A	8.02	19.9	-	-	1.1	Nut Q = 0.94 gph; SF#1/#2 = 1.6 gph; Increase QR2 to 1 gpm
		EFFLUENT	N/A	8.16	19.8	-	-	1.3	N/A	8.23	19.6	-	-	1.1	Final Effluent: pH = 8.28, T = 19.5, DO = 1.1
10/14/2002	6:50am	INFLUENT	1	-	-	-	-	-	1.06	-	-	-	-	-	Qtot(R1) = 17,727 gal, Qav = gpm, Qtot(R2) = 16,898 gal, Q av = gpm
															Pressures: R1 - inlet (16 psi), Int (4.5 psi), Outlet (0 psi); R2 - Inlet (10 psi), Int - (2.5 psi), Outlet - (0 psi)
	7:15am	INFLUENT	-	7.33	18.6	-	-	5.8	-	Same for both					
		INTERMED	N/A	8.03	18.5	-	-	1	N/A	8.32	18.5	-	-	1.3	
		EFFLUENT	N/A	8.12	18.2	-	-	1.4	N/A	8.37	18.3	-	-	1.1	Final Effluent: pH = 8.18, T = 17.6, DO = 0.9
	12:30pm														Collect samples for analysis
	3:00pm														Adjusted Q's to 1 gpm (noticed both were about 1.2 gpm at 1:00 pm)
10/15/2002	10:00am	INFLUENT	-	7.14	19.5	-	-	8.5	-	Same for both					Pressures: R1 - Inlet (18 psi), Int (4.5 psi), Outlet (0 psi); R2 - Inlet - (11 psi), Int - (2.5 psi), Outlet - (0 psi)
		INTERMED	N/A	7.87	19.3	-	-	1.8	N/A	8.17	19.2	-	-	2	Nut Q = 0.94 gph; SF#1/#2 = 1.6 gph; Increase QR2 to 1 gpm
		EFFLUENT	N/A	8.02	19	-	-	1.6	N/A	8.16	18.8	-	-	1	Final Effluent: pH = 8.28, T = 19.5, DO = 1.1
10/16/2002	11:15am	INFLUENT	-	7.6	18.5	-	-	7	-	Same for both					Pressures: R1 - Inlet (18 psi), Int (4.5 psi), Outlet (0 psi); R2 - Inlet - (11 psi), Int - (2.5 psi), Outlet - (0 psi)
		INTERMED	N/A	7.63	19.1	-	-	2	N/A	8.29	19.2	-	-	2.4	Nut Q = 0.94 gph; SF#1/#2 = 1.6 gph; Increase QR2 to 1 gpm
		EFFLUENT	N/A	7.89	19.1	-	-	1.4	N/A	8.4	19	-	-	1.7	ST feed rates about 5 gph overnight
	2:30pm	INFLUENT	-	7.42	19.3	-	-	7	-	Same for both					Pressures: R1 - Inlet (18 psi), Int (4.5 psi), Outlet (0 psi); R2 - Inlet - (11 psi), Int - (2.5 psi), Outlet - (0 psi)
		INTERMED	N/A	7.56	19.7	-	-	2.1	N/A	8.29	19.7	-	-	2.1	Nut Q = 0.94 gph; SF#1/#2 = 1.6 gph; Increase QR2 to 1 gpm
		EFFLUENT	N/A	7.87	19.5	-	-	1.4	N/A	8.37	19.5	-	-	1.4	Final Effluent: pH = 8.16, T = 19.3, DO = 1.1
10/17/2002	9:15am	INFLUENT	0.7	-	-	-	-	-	0.47	-	-	-	-	-	Qtot(R1) = 20,922 gal; Qtot(R2) = 22,170 gal
															Pressures: R1 - Inlet (18-19 psi), Int - (4 psi), Outlet - (2.5 psi); R2 - Inlet (11 psi), Int - (3.5 psi), Outlet - (2.5 psi)
															Computed average flow rates for Mon-Thur (72 hr): 1 gpm for R1 and 0.9 gpm for R2
	11:45am	INFLUENT	-	7.2	20	-	-	7.8	-	Same for both					Pressures: R1 - Inlet (18 psi), Int (4.5 psi), Outlet (0 psi); R2 - Inlet - (11 psi), Int - (2.5 psi), Outlet - (0 psi)
		INTERMED	N/A	7.83	19.8	-	-	2	N/A	8.34	20.2	-	-	1	Nut Q = 0.94 gph; SF#1/#2 = 1.6 gph; Increase QR2 to 1 gpm
		EFFLUENT	N/A	7.9	19.8	-	-	1.3	N/A	8.42	19.9	-	-	1.1	Final Effluent: pH = 7.97, T = 20.3, DO = 1.4
	4:30pm	INFLUENT	0.98	-	-	-	-	-	1	-	-	-	-	-	Qtot(R1) = 22600 gal; Qtot(R2) = 21340 gal (adjusted QR2 - was about 0.9 gpm)
10/18/2002	9:00am	INFLUENT	1.08	-	-	-	-	-	0.87	-	-	-	-	-	Qtot(R1) = 23642 gal; Qtot(R2) = 22,240 gal; Qavg R1 = 1.02 gpm (17 h), Qavg R2 = 0.88 gpm (17 h)
															Pressures: R1 - Inlet (19 psi), Int (5 psi), Outlet (0 psi); R2 - Inlet (13 psi), Int (2.5 psi), Outlet - (0 psi)
															ST feed rates about 5 gph overnight
	10:00am	INFLUENT	-	7.32	19.6	-	-	7.2	-	Same for both					Pressures: R1 - Inlet (18 psi), Int (4.5 psi), Outlet (0 psi); R2 - Inlet - (11 psi), Int - (2.5 psi), Outlet - (0 psi)
		INTERMED	N/A	7.96	19.5	-	-	1.4	N/A	8.22	19.8	-	-	2.6	Nut Q = 0.94 gph; SF#1/#2 = 1.6 gph; Increase QR2 to 1 gpm
		EFFLUENT	N/A	8.1	19.4	-	-	2	N/A	8.31	19.6	-	-	1.7	Final Effluent: pH =8.23, T = 19.1, DO = 2.0
	10:25am														Collect samples for analysis
	2:45pm	INFLUENT	-	7.41	20.4	-	-	8.5	-	Same for both					Pressures: R1 - Inlet (18 psi), Int (4.5 psi), Outlet (0 psi); R2 - Inlet - (11 psi), Int - (2.5 psi), Outlet - (0 psi)
		INTERMED	N/A	7.9	20.7	-	-	0.4	N/A	8.15	20.8	-	-	2	Nut Q = 0.94 gph; SF#1/#2 = 1.6 gph; Increase QR2 to 1 gpm
		EFFLUENT	N/A	7.97	20.6	-	-	1.4	N/A	8.19	20.8	-	-	1.4	
	3:20pm														Collect samples for analysis

- Not measured
N/A Not applicable
gpm - gallons per minute
gph - gallons per hour
NTU - nephelometric turbidity unit
mS/cm - microsiemens per centimeter
NaAc - sodium acetate
Ac^- - acetate ion
ST - substrate tank (see Figure 3)
SF - substrate feed
Nut - nutrient
NR - not recorded